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ABSTRACT

This report describes a collection of procedures, with illustrative examples, for selecting and portraying microcomputer courseware in a manner that enables others to make their own judgments of courseware quality. Following a discussion of perspective and a report outline, section 3 deals with assumptions underlying the search to identify specific aspects of courseware form to illuminate. A fourth section describes the data sets selected as most relevant for the portrayal of courseware structure, and a rationale for the purpose of courseware structure portrayal and for specific portrayal content is provided in section 5. The sixth section presents three illustrative portrayal strategies for courseware criticism, including a mastery model analysis comparative table; a narrative of student courseware use with a flow chart of inferred courseware structure; and brief summary flow charts of two student paths and a simplified, inferred, author-designed path. Section 7 outlines a proposal for testing the effects of different kinds of portrayal, while section 8 presents an example of the use of an open-ended evaluation check list for conducting microcomputer courseware criticism. Appendices provide guidelines for structured observation of student paths through microcomputer courseware and a copy of the evaluation checklist with instructions included. A 15-item bibliography concludes the report. (ESR)

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No. 76

MAKING COURSEWARE TRANSPARENT: BEYOND INITIAL SCREENING

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November 1982

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PREFACE

The Research on Evaluation Program is a Northwest Regional Educational Laboratory project of research, development, testing, and training designed to create new evaluation methodologies for use in education. This document is one of a series of papers and reports produced by program staff, visiting scholars, adjunct scholars, and project collaborators--all members of a cooperative network of colleagues working on the development of new methodologies.

How can one evaluate microcomputer courseware in a way that helps others make their own judgments of its quality? What alternative styles of evaluative presentations are available? This report answers these and related questions by describing a collection of procedures, with illustrative examples, for selecting and portraying evaluative information. A checklist for conducting microcomputer courseware criticism is also included.

Nick L. Smith, Editor
Paper and Report Series

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MAKING COURSEWARE TRANSPARENT:

BEYOND INITIAL SCREENING

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It is argued elsewhere that the kind of criticism most needed today is that which helps us to see how things work (Della-Piana, 1981a). The possibilities of applying that perspective to meta-evaluation and the evaluation of microcomputer-based instruction were sketched out in previous reports (Della-Piana, 1981b, 1981c).. In the present report we briefly restate the perspective of evaluation as "making a work transparent" and outline more clearly a methodology for gathering and portraying data within such a framework, with special application to criticism of microcomputer-based instruction.

1.0 The Perspective

The kind of criticism that our perspective opposes is that which gives us the definitive interpretation as to what a piece of courseware is about or makes the final judgment in the sense of pronouncing the courseware as good or bad for us. To give a final interpretation, paraphrase, or summary judgment of a work puts an end to it. It does the thinking and feeling for the user. It makes the user's response unnecessary. It may even, in the long run, make the user helpless or dependent upon others for critical interpretation and judgment. As for the courseware developer or distributor, it may produce defensiveness or complacency with respect to the need for revision. Our perspective is

that the function of criticism is to show how things work, to make them transparent, to demystify. But it is not enough to show how things work. The portrayal of the workings of a piece of courseware must have utility for two audiences. It must involve users in making their own interpretations, judgments and adaptations of the courseware for their own purposes. It must involve developers and distributors in "revision," in seeing the work again or looking back at it from a perspective that may drive redevelopment.

2.0 Outline of the Report

The remainder of this report will proceed as follows. Section 3.0 deals with assumptions underlying the search for which aspects of form to illuminate. Specifically, we will be concerned with the implications of information processing capacity, the state of the art on how to design instruction, and the utility of different kinds of data as guides to what kind of information to gather. In Section 4.0 we outline the data sets we have selected as most relevant to the portrayal of the structure of courseware. In Section 5.0 we provide a rationale for the purpose of portrayal of courseware structure and the content of portrayals. The emphasis on purpose is on how portrayal may serve the audiences to which it is directed. The emphasis on content is on how juxtapositions of data provide dissonance that involves readers in making their own interpretations and judgments. Section 6.0 presents three illustrative portrayal strategies for courseware criticism. Section 7.0 outlines how we would propose to test the effects of different kinds of portrayal and, finally, Section 8.0 presents an "open-ended checklist" consistent with our courseware criticism perspective along with an example of

its use. The checklist is an attempt to provide a simpler application of our perspective that goes beyond the popular checklists, but not so much in depth as the methodology we propose in previous sections.

3.0 Assumptions Underlying the Search for What to Illuminate

If we are to make courseware transparent, we must decide on what in the courseware one might best illuminate for the purposes noted above. But where shall we find a framework to guide us in selecting what is to be portrayed? There is certainly no agreed-upon technology of instruction. Computer hardware is changing rapidly, system components are changing (e.g., video discs and interactive operation of microcomputers with larger time-sharing systems, greater capacity of microcomputers), authoring systems are primitive and likely to change rapidly, and courseware itself has not even caught up with present possibilities. Indeed, the contexts in which courseware will be used for jobs and their social, political and economic contexts, are relatively unknown to us. Thus, protrayal of courseware structures of today will likely be irrelevant to the courseware of the near future and any particular instance of courseware criticism could easily appear irrelevant except for historic analysis or as a source of ideas or strategies to avoid or pursue further.

Given the rapidly changing form of computer hardware, software, authoring systems, courseware and contexts of use, we have sought a set of guiding assumptions that might lead us to focus on data that illuminate the structure of courseware in ways that have immediate utility and some long-term value. The following six assumptions seem to us to be appropriate guides.

First, the potential user of courseware is an information processing system of limited capacity (Simon, 1971, pp. 40, 41, 62). In other words, there are limits to the amount of data or number of variables

that a person can efficiently attend to. This suggests the need to search for an appropriately limited and useful subset of courseware structures for the user to grasp and process. We need to do more than "spew out data in forms which human beings then have to process extensively."

Second, instructional prescriptions derived from cognitive, developmental or behavioral psychology must be viewed as testable contemporary hunches rather than as procedural laws. Thus, prescriptions may be tentative guides to instructional design and development, but they are best seen as hypotheses concerning instruction derived from constructs and thus as interpretations that must be validated in many contexts. A prescriptive science of design does not appear to be at hand (Calfee, 1981; Glaser, 1982; Resnick, 1981).

Third, the perhaps most valuable data set against which all others may be usefully juxtaposed is a detailed description of the cognitive processes of the student working through an instructional sequence (Resnick, 1981, p. 693). This kind of information has immediate practical utility for diagnosis or adaptation of instruction to individual differences as well as long-range utility for generating significant instructional prescriptions.

Fourth, any reasonably permanent set of criteria for courseware criticism must derive from the experience of application to many instructional packages in many subject domains. It is only upon the base of numerous case studies that critical criteria and procedures may be refined and primarily then that it would be useful to judge the criteria and procedures against critical competitors.

Fifth, the portrayal of the structure of a specific piece of courseware will vary for different audiences. In our work, the portrayal will always be for the purpose of helping the user and the developer/distributor. The focus for users will be on helping them make their own interpretations and judgments about instructional utility for their own purposes or designing ways of modifying or using courseware already selected. For the developer/distributor the focus will be on helping them to look again at their courseware for purposes of redevelopment or for modifying their representations as to how the courseware accomplishes what it does accomplish or what might be accomplished (Della-Piana, 1981, pp. 211-246; Smith, 1982, pp. 177-304).

Sixth, courseware criticism will typically be based in part on a form of naturalistic inquiry and must be subject to the usual canons of such inquiry (Guba and Lincoln, 1981, pp. 85-127). In addition, it must specifically attend to the interdependency of such instruction with other systems surrounding it (Bronfenbrenner, 1979), the characteristics of learners, economy or worth in relation to cost, and generalizability of performance across different contexts (Gilbert, 1978, pp. 284-286).

4.0 Data Sets to be Illuminated

Figure 1.0 presents graphically the data sets that we see as most relevant to the portrayal of the structure of courseware consistent with the above assumptions. In this section we provide a general orientation to those data sets and to the methodology for gathering data.

The author-defined domain of the courseware is derived from three data sources. The manual or courseware itself may literally specify objectives or intents of the author as to what the courseware is

designed to accomplish. Some author objectives may be inferred from an examination of the instructional strategy and content. Other author objectives may be inferred from an analysis of the final mastery test for the course, if there is one, or from submastery tests. The author-defined domain is what is designed to happen as the student goes through the courseware and completes it.

The student-defined domain of the courseware is derived from three data sources. When we say "student-defined domain" we mean to suggest that what the course is may be defined in part by what the student does in going through the course or upon completion of the course and presumably as a result of the course. The instructional patn of the student in using the manual, in using other supportive material, and in interaction with the computer, defines what the course is for a student. Likewise, when the student seeks or gets assistance from live interaction with a teacher, aide, or peers, this too helps to define the actual course for a student. And the student's performance on submastery or final mastery tests in relation to his/her aptitude also defines what the course is or was for the student. The student-defined domain is what does happen as the student goes through a course and completes it.

The ideal-defined domain of the courseware is also derived from three sources of data. When we say "ideal-defined domain" we mean to suggest what the course might be given some specific set of user assumptions. "Valued accomplishments" related to the course may be determined by some rational consensual procedure applied to policy-shaping members of a community (subject-matter experts, on-line administrators, patrons of the school). This would help define the "ideal" course. However, the number of accomplishments some policy-shaping group might hope for

is likely to be beyond what could reasonably be achieved. Thus, such a list may be reduced by empirical test or informed hunches as to which subset of valued accomplishments one might "teach-towards" that would, as a by-product, also get the largest number of other valued accomplishments. For example, if one taught "reading comprehension" without any written work, the student would not learn to write. But if one taught writing in certain ways, one would also likely get accomplishments in reading comprehension. Finally, a list of valued accomplishments may be reduced further by de-selection of those for which there is the least favorable ratio of accomplishments to costs of instruction. The ideal-defined domain is thus what should happen as the student goes through the course and completes it.

Overlapping data sets are indicated in part by areas A, B, C, D, in Figure 1.0. It is the points of consistency and inconsistency both within a data set (e.g., author-defined objectives literally stated versus those inferred from final mastery tests or instructional strategy) and among data sets (areas labelled A, B, C, D in Figure 1.0) that should be the focus for portrayals of what courseware accomplishes and how it accomplishes what it does.

The number of possible overlapping data sets is of course quite large. Thus, in practice, one must choose which juxtapositions to portray. At this stage of our thinking on the matter, we believe that the choice will be largely subjective with an eye to portrayal of data which appears most likely to achieve the objectives suggested in Section 1.0, "The Perspective," and in Section 2.0 on "Assumptions Underlying the Search for What to Illuminate."

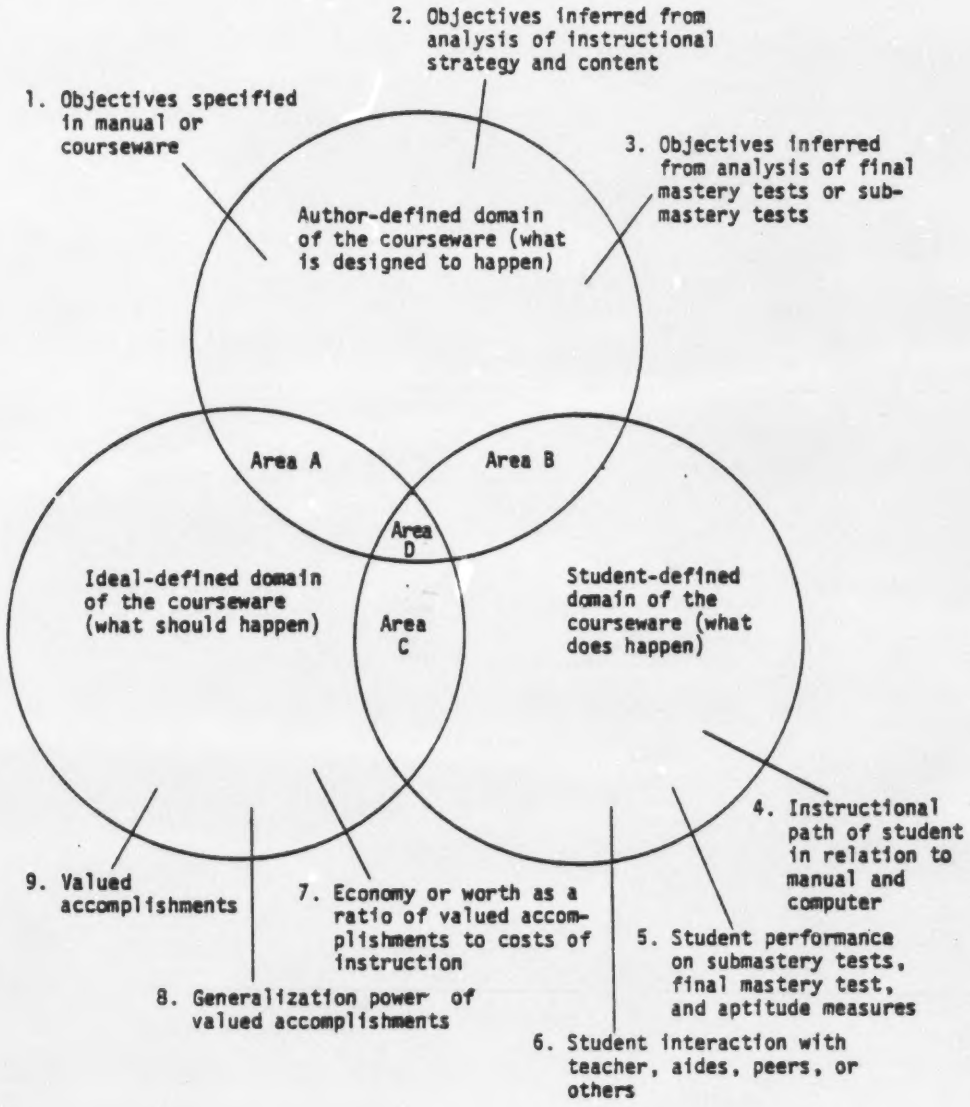
2. Objectives inferred from analysis of instructional strategy and content
1. Objectives specified in manual or courseware
3. Objectives inferred from analysis of final mastery tests or sub-mastery tests
Author-defined domain of the courseware (what is designed to happen)
Area A
Area B
Area D
Ideal-defined domain of the courseware (what should happen)
Area C
Student-defined domain of the courseware (what does happen)
4. Instructional path of student in relation to manual and computer
9. Valued accomplishments
7. Economy or worth as a ratio of valued accomplishments to costs of instruction
5. Student performance on submastery tests, final mastery test, and aptitude measures
8. Generalization power of valued accomplishments
6. Student interaction with teacher, aides, peers, or others

FIGURE 1.0. A graphic representation of nine sources of data for making microcomputer courseware transparent. It is the juxtaposition of data represented by areas A, B, C, and D that is the focus for portrayal of courseware.

Procedures for Obtaining Data are presented in summary form in Table 1.0 for each of the data sources relevant to the three vantage points for defining the domain of the courseware. A description of all these procedures is beyond the scope of the present report. One set of procedures (for structured observation of student path through the courseware) is presented in some detail in Appendix A. Other procedures will be illustrated in later sections, but not presented in detail. Any competent evaluator knows how to gather such data.

An examination of the summary of procedures in Table 1.0 suggests that the kind of criticism proposed is based on data that must be gathered and analyzed under the direction of personnel with competency in cognitive process analysis, knowledge of the subject matter of the courseware, knowledge of instructional design process, and skill in evaluation of instruction. Naturally, this would ordinarily require a team of critics. This is a big order and such intensive criticism should certainly be limited to courseware that is worth the attention because of being exemplary in some important ways. However, in a later section, we will also propose a "checklist approach" consistent with our perspective. The checklist is designed for less time-consuming criticism and for more general use consistent with the perspective of the more in-depth criticism.

5.0 Data Portrayal: Purpose and Content

How one presents the results of one's critical analysis should take into account the purpose of the portrayal in relation to specific audiences. In this section, we outline briefly some purposes we see as appropriate and some juxtapositions of information relevant to these purposes.

TABLE 1.0

DATA GATHERING PROCEDURES APPROPRIATE TO THREE PERSPECTIVES FOR DEFINING A COURSEWARE PACKAGE

Domain Definition Strategies	
Data Sources for Each Domain Category	Procedures for Obtaining Data
Author-Defined Domain 1. Objectives specified in courseware, manual or other supportive material. 2. Objectives inferred from analysis of instructional strategy. 3. Objectives inferred from analysis of final mastery test.	a) Collection of objectives stated within the courseware (on the computer monitor) or in other supportive material. The objectives may be reorganized according to some system for formal specification of objectives. b) Evaluator-inferred objectives as determined by going through the "course" as a student and noting what the instructional strategies appear to teach. c) Evaluator-inferred objectives as determined by evaluator analysis of final mastery test or submastery tests.
Student-Defined Domain 4. Instructional path of student in relation to computer interaction and supportive material. 5. Student performance on submastery and final mastery tests as function of aptitude. 6. Student interaction with teachers, aides, peers or "noncourse" sources of information.	d) Hard-copy printout of student responses while going through computer-aided instruction. e) Workbook (or other comparable response sheet) responses associated with the courseware package. f) Structured interviews with students after completion of instructional segments on critical points within the instruction. g) Observation of students during instruction re. interaction with computers, supportive materials, peers, or others and follow-up interviews of key persons. h) Student performance on submastery and mastery tests.
Ideal-Defined Domain 7. Valued courseware-related accomplishments as judged by appropriate policy-shaping community. 8. Generalization power of valued accomplishments. 9. Economy or worth of instruction as a ratio of valued accomplishments to costs of instruction.	i) Judgments of value of alternative models of accomplishments as determined by a committee using some sort of informed consensus process. j) Estimates of generalization power of value accomplishments based on empirical tryout data or informed hunches; (does mastery generalize to other valued accomplishments?). k) Estimation of the worth of instruction based on actual/estimated costs and judged value of the accomplishments.

Purposes for Portrayal of Courseware Criticism. In Table 2.0 we summarize some major purposes of portrayal of courseware criticism in relation to specific audiences. There are, of course, other audiences and other portrayal purposes. Earlier in this paper (Section 1.0 and the sixth assumption in Section 3.0) we made clear our perspective that courseware criticism should illuminate how things work in a way that involves people in making their own interpretations and judgments. Table 2.0 does not in itself make that perspective clear. Thus, we emphasize it here. For example, the purpose of criticism "for the buyer" is to guide selection of packages to "try out." It would be possible to list criteria, have the prospective buyer apply the criteria and come up with a number which can be put in a decision algorithm, such as: buy if your rating is eight or higher, don't buy if the rating is three or lower, and get more information or examine critical competitors if the rating is between four and seven. We feel that such algorithms are useful for selling. However, for buying, the portrayal of courseware criticism should illuminate significant structures in the courseware so that the prospective buyer can see how it works and make his/her own interpretations and judgments as to its utility for his/her purposes and contexts.

Focus on Juxtapositions of Data Sets. We have said that our purpose for portrayal is to involve people in making their own interpretations and judgments about courseware in relation to their own uses. One way of involving people in making their own interpretations is to create dissonance. And one way of creating dissonance is to juxtapose data sets that are likely to create dissonance. In Figure 1.0 the juxtapositions we propose are represented not only by overlapping areas

TABLE 2.0

SUMMARY OF PURPOSES OF PORTRAYAL OF MICROCOMPUTER COURSEWARE CRITICISM FOR SELECTED AUDIENCES

Audience for the Criticism	Purposes of the Criticism
The buyer of instructional packages (supervisor, administrator, teacher or school-community committee)	Guide selection of packages to "try out."
The teacher coaching, consulting or advising students using the courseware.	Guide adaptation of the courseware or proposed utilization procedures for use within one's own context.
The student user of the courseware.	Motivate (by showing what can be accomplished) and inform on use and overcoming obstacles to use.
The designer/developer/distributor of the courseware package.	Motivate to redevelop or supplement, or modify representations of current courseware. Motivate to change design/development procedures in the future. Motivate to modify representations of future courseware.

A, B, C, and D, but also by juxtapositions within a data set. The number of possible juxtapositions of nine sources of data taken two at a time, regardless of order, is thirty-six. When one includes juxtapositions three at a time and also the numerous kinds of data within any given data source, the number of possible juxtapositions of data goes beyond the magnitude to which one can give serious attention. As we have indicated before, we have no easy solution to the criteria for clustering or chunking such information. Our preference is to consider at least the thirty-six possibilities and select subjectively some subset of data juxtapositions to portray. To give the reader a sense of how such jxutapositions may provide dissonance that involves one in making interpretations, we have summarized some illustrative data juxtapositions in Table 3.0. The illustrations are not intended as proper portrayals to produce involvement in the reader, but rather as examples of the kinds of data that could effectively be juxtaposed to obtain involvement of the reader.

6.0 Illustrative Strategies for Portrayal of Courseware Criticism

In this section we provide three illustrations of portrayal strategies for courseware criticism. Recent explorations of alternative evaluation strategies have been coupled with explorations in ways of communicating the outcomes of evaluation. For a survey of communication strategies in evaluation, the reader is referred to the third volume in the series on *New Perspectives in Evaluation*, edited by Nick L. Smith (1982). The strategies we illustrate here are designed to portray the kinds of data juxtapositions we have outlined above (see Figure 1.0 and Table 3.0) and to accomplish the purposes for courseware criticism also presented above (see Section 4.0).

TABLE 3.0

ILLUSTRATIVE DATA SET JUXTAPOSITIONS FOR AUTHOR-DEFINED, STUDENT-DEFINED AND IDEAL-DEFINED DOMAINS OF MICROCOMPUTER COURSEWARE

Juxtaposition (See Figure 1.0)	Illustration of Kinds of Information That Might Be in Portrayals for Selected Data Juxtapositions
Author-Defined (specified) and Author-Defined (inferred) and Student-Defined	A drill and practice program is designed by the author to "increase accuracy and rate of performance in arithmetic fundamentals through massive practice and immediate feedback." The instructional strategy includes 60% of the time on any frame devoted to feedback such as fireworks flashing across the monitor and correct answer confirmation. A large portion of students (20%) lose interest, miss feedback, and punch in responses without much conscious attention.
Student-Defined and Author-Defined	A program for writing poetry with a computer is designed by the authors so that students input words tagged according to part of speech and retrieve by grammatical category to "write a poem" with the computer randomly selecting words from a category. Amateur writers experiment with word order and kinds of words used as input. Inexperienced writers input words with difficulty, retrieve in chaotic order, and give up after doing one "poem."
Student-Defined (instructional path) and Student-Defined (performance on aptitude measures and mastery tests)	A student goes through a program to "teach intermediate-grade children punctuation and capitalization." The student path is as follows: the student reads a sentence, moves a cursor on the monitor (stopping it when punctuation or capitalization is needed), and strikes the key number corresponding to the appropriate response taken from alternatives at the bottom of the page. Students who cannot read the material with proper intonation respond randomly and perform poorly on the mastery tests.
Author-Defined and Ideal-Defined	In a computer literacy program, a unit on history of computers is designed by the authors to match names of computer pioneers with specific major accomplishments and place the accomplishments on a time line. An ideal goal for history of computers would be to have students predict the effects on society of this new technology based on an analysis of the effects of past technologies and knowledge of the current situation.
Ideal-Defined and Student-Defined	A drill and practice program for basic arithmetic facts is used by students who are insecure as follows: when asked to specify number of digits and speed of presentation, they set standards unrealistically high (discouraging) or unrealistically low (no improvement over current skills). Ideal programming puts item difficulty and response time under student control, but provides feedback on student response history to accommodate individual differences.

Mastery Model Analysis Comparative Table. This portrayal strategy is based on the thematic matrix analysis procedure outlined in Della-Piana (1981, pp. 216-219). In the present case the form is a comparative table. The data juxtaposition is an author-defined objective for part of a computer literacy program and an ideal-defined objective for such a program. The portrayal is presented in Table 4.0 in a summary form. The first three columns of the table define a "mastery model" or objective of instruction. There are two alternative mastery models for comparison. The top example (A) is an "author-defined" model of what to teach towards and how to assess accomplishment of the stated objective. The model was abstracted by inference from courseware and accompanying material. The bottom example (B) is an "ideal-defined" model of what to teach towards. The ideal was derived from an analysis of the subject matter of social studies (Gilbert, 1976) as a source of predictive power. The table itself is adapted from a form designed also by Gilbert (1978, pp. 284-286). What stands out in the analysis is that the author-defined mastery model (roughly recalling important events in the history of computers and placing them on a time line) is economical to assess and matches the stated general objective, but probably does not generalize to a more important objective (roughly, "using knowledge of past history of technology to predict effects of computer technology"). The "ideal-defined" mastery model on the other hand does not match the stated general objective, is a perhaps more appropriate goal for the study of history of computers, is expensive to assess, but will likely generalize to the stated general objective. That is, people who master the "ideal-defined" accomplishments will most likely also be able to perform well on the author-defined model. Thus,

TABLE 4.0

MASTERY MODEL ANALYSIS COMPARATIVE TABLE*

Student Population: Junior High School
General Objective: Recall major events in development of computer and place them accurately (±5 yrs) in time.

	Alternative Mastery Models					Economy			
	Situation	Response	Artifact	Importance	Generalizability	(S)	(R)	(A)	Choice
Author-Defined Objectives	A. Given: Marked time line from 1600 to 2000 A.D. List of key historical events covering the period. Instructions: Place two events from each century on the time line and recall and record computer history events on the time line.	Select general historical events from list and accurately place two in each century. Write along time line major computer events recalled.	The drawn time line with several historical and computer history events drawn in.	Primary: The mastery model specifications for guiding assessment match the stated objective rather well.	Partial or incomplete transfer is expected to "B." If one is able to demonstrate this accomplishment, one is not necessarily able to demonstrate accomplishment B. Also, "teaching towards" A will not likely get you B.	Situation. Economical to set up testing conditions and to prepare the test. Response. Written response requires only pencil and paper and is thus very inexpensive. Artifact. Scoring key not difficult or expensive to develop. Scoring by hand moderately expensive.			The question is: Do you want to measure and teach toward something that is inexpensive to accomplish, matches the stated objective, but does not match a more appropriate goal of the study of history?
Ideal-Defined Objectives	(B) Given: Marked time line from 1600 to 2000 A.D. List of technological developments including computer history events placed on the time line. Instructions: Select one or more technological developments for comparative analysis with new computer technology. Analyze and predict parallel effects on economic and social systems.	Select some technological development for comparative analysis with computer technology. Write predictions of effect of computer technology along with analysis of parallel effects in other technologies and reasons for prediction.	The drawn time line with computer history events drawn in. Written predictions and comparative analysis of effects of computer technology and some other technological development.	Secondary. The mastery model specifications are secondary to the stated objective. Primary. The mastery model stated is primary for an alternative objective "use of history as a source of predictive power." This seems a more appropriate goal.	Complete transfer expected to "A." If one has ability "B," one likely has ability "A." Also, "teaching towards" B will likely give one mastery of A also.	Situation. Test preparation moderately expensive, but economical to set up conditions. Response. Written response requires only pencil and paper and thus is inexpensive. Artifact. Scoring key difficulty and expensive to develop. Scoring relatively inexpensive.			The question is: Is it worth this extra time and expense to get this accomplishment along with accomplishment A?

*This is an impressionistic analysis of two testing alternatives. Judgments of importance, generalizability, and economy should be based on empirical data. Mastery Model "A" is an author-defined objective and Mastery Model "B" is an "ideal-defined" objective.

the choice appears to be between economy and relevance or a matter of "is the relevance worth the cost?"

Narrative of Student Use of Courseware Against Background of a Flowchart of the Inferred Courseware Structure. This strategy has elements of what we have elsewhere called "accurate, sharp, loving description" (Della-Piana, 1981, pp. 218-223). We have said that the perhaps most useful way to illuminate the structure of courseware or how it works is to follow a student path through the instruction. In the present illustration, the portrayal is in the form of a flowchart and accompanying narrative. The courseware used for illustration is the MECC (Minnesota Educational Computing Consortium) program on "Poetry," the purpose of which is stated as a "joint effort between people and computer to write Poetry." The data juxtaposition is an author-defined path of instruction (inferred by the evaluator going through the instruction to see how it worked) in the form of a flowchart, along with a student-defined path of instruction (determined by collecting printouts, observing a writer going through the program, and interviewing the writer). The student-defined path is presented in narrative form and should be read with the flowchart (Figure 2.0) in hand. Get a copy of Figure 2.0 in hand and follow the flowchart as you read this much-abbreviated description of a student's path through the instruction. (The description is edited to illustrate portrayal method, but poems used are selected poems produced by the student writer.)

The student is a college graduate and an unpublished occasional "writer of poetry." He starts the "Poetry" program (inserts diskette, etc.) and types "yes" at step one (instructions desired?), whereupon he reads instructions in steps two and three. There are two steps

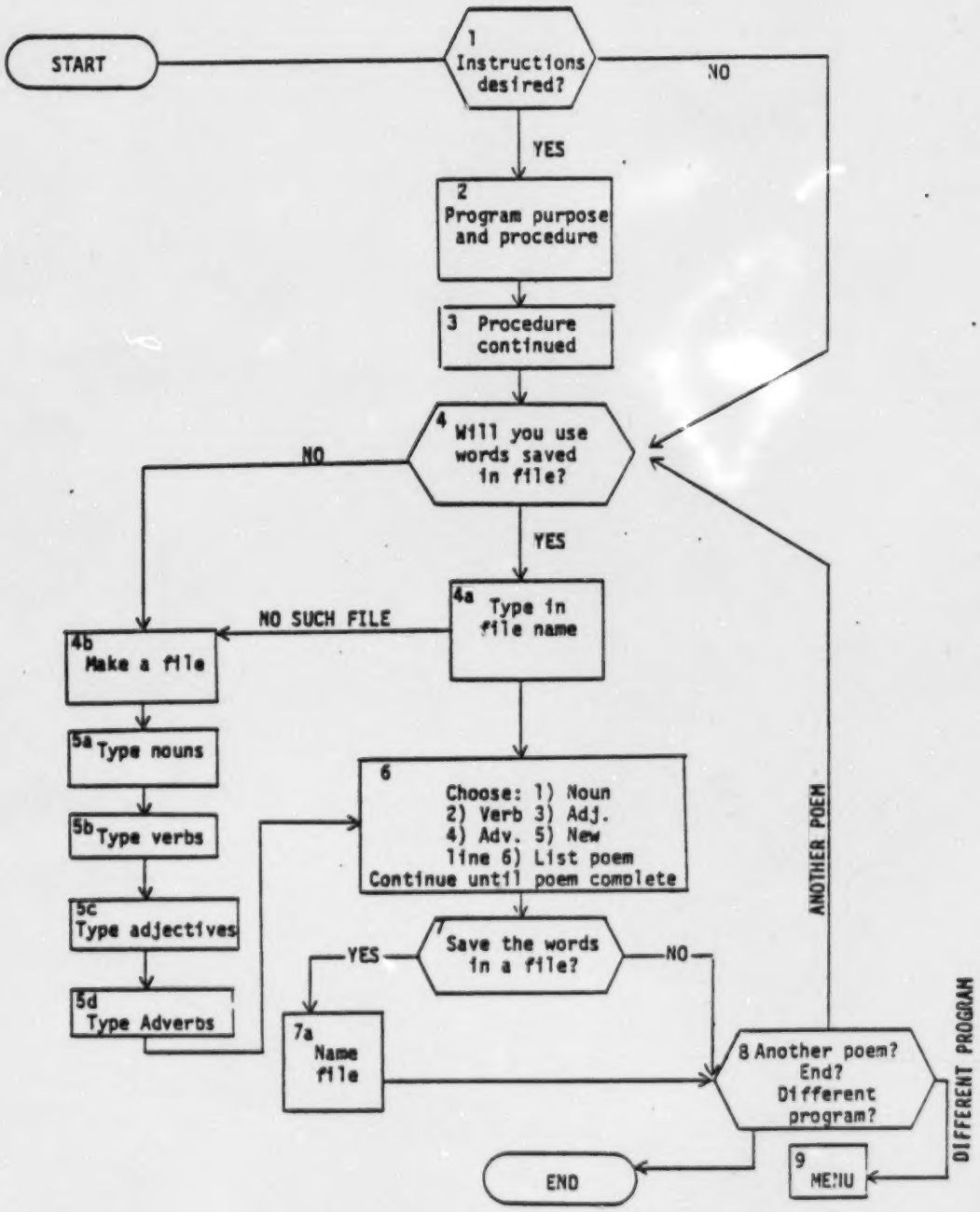

FIGURE 2.0. Flow chart of MECC Elementary, Volume 2, Version 1, Menu Item #7, "Poetry."

for instructions because it won't all fit on one frame. The writer reads part of it aloud, ". . a joint effort between people and computer to write poetry." He comments that "You know, you can read those instructions and have no idea as to what you will be required to do." The observer says, "You may go back and reread if you wish, or go on." He goes on. But before he does, he says, "I don't know about this 40 characters per line and 48 lines, but I suppose they will remind me." He goes on to step four (will you use words saved in a file?). He says "sure" and types "yes," but the message he gets is "Type in the file name" and he realizes he has no file. So he types "X" and gets the message that the computer "can't find it" and that he has to "use new words." He is then instructed to type nouns (5a), verbs (5b), adjectives (5c), and adverbs (5d). He types in the following after a reflective pause:

nouns---city, wind, garbage

verbs---smile, jump, speed

adjectives---original, strange, obsolete

adverbs---forever, intricately, fast

The student goes on to step six where he is asked now to write a poem with the computer by choosing some sequence of noun, verb, adjective, adverb to form lines of a poem (presumably up to 48 lines and 40 characters per line). He decides on a four-line poem, but seems puzzled as to what the program is about. "What are we trying to do?" he says to himself. But he goes on again and types in the following, in the proper manner, signaling the computer to retrieve words (in, presumably, some random fashion) from each grammatical category and place them in sequence as indicated. He calls for:

line 1: noun adverb adjective noun

line 2: adjective noun adverb verb

line 3: adverb verb noun noun

line 4: adjective adjective adverb

He then types in a #6 (list poem) when asked for "new wish" and the following comes up on the monitor:

city forever original wind

intricately speed city garbage

strange original fast

The student commented that this was "Not a bad poem for one written so mechanically," and added, "but I'm not sure this teaches poetry writing." During a brief probing session, the writer indicated that the words he put in were not entirely without thought and his retrieval sequence for word order was selected to avoid standard-prose grammatical sentence patterns so that ". . it might sound more like poetry or so that something interesting might happen." But for this student there was something intriguing about the process and he decided to save the words in a file (step 7), naming it "Garbage," and then used the same word file for two other poems which came out like this:

garbage speed garbage

wind fast jump wind

city forever speed strange wind

speed wind garbage city

city forever obsolete

forever smile garbage

strange strange intricately

The only comments the writer made were that both poems seemed fair considering the constraints, but that the last word (intricately) in the second poem seemed inappropriate. He noted that this process might well encourage experimentation with word order and might at least "generate ideas for poems." He also suggested that experimenting with "words put

in" might be interesting and tried that the next time he chose to work on the program.

In the next session he created a new word file by making a chart with noun, verb, adjective, adverb heading the columns and clusters of letters of the alphabet for rows (e.g., ab, cde, fg, hi, kl, mnt). He then put words in each cell as they occurred to him. The results for two attempts at poems using this file were discouraging to the writer. One "poem" was:

baker live plant
ship weekly trip head
wave always open quick air
truck wait miss miss
pass wave duck kitten

The observer asked the writer to comment on what happened. "This is pretty bad, pretty bad," he said, shaking his head. "Maybe I was lucky the first time. But I think I was really free-associating words to input that might fit together somehow. It wasn't really as random as I did for the last two poems. It was something like this:

nouns: city (let's see what goes on in the city), wind (I'm thinking of Chicago) and garbage (remember when the garbage collectors were on strike? Was that Chicago or New York?)

verbs: smile (let's try to be happy anyhow), and jump and speed (some active things)

adjectives: I don't like adjectives. But let's see, original (like strawberries with seeds on the outside), strange (I guess original is also strange, but a

different connotation) and, let's see, obsolete (garbage should be obsolete. It's certainly strange and gets mighty original at times).

adverbs: I like adverbs less than adjectives. Let's see, they are tied to verbs. Forever (smile forever) and fast (fast jump. I don't know. Speed made me think of fast. That's great. Speed is a noun too). Intricately (I like that word; let's modify all verbs with intricately. Life is complex.).

The writer was worn out and stopped the session here.

The next day the writer made a sixth try. He decided to take words from a poem by e. e. cummings and did so, putting them down in columns and then putting them in a word file as follows:

Noun	Verb	Adjective	Adverb
spring	is	perhaps	carefully
hand	comes	strange	
nowhere	arranging	known	
window	look	like	
people	stare	new	
thing	changing	old	
everything	placing		
fraction	breaking		
flower			
inch			
air			
anything			

The poem is, of course, "Spring is like a perhaps hand." The word order requested by the writer for retrieval in step six was:

noun	verb	adjective	noun
adverb	verb	adjective	noun
adverb	verb	adjective	noun
noun	verb		
noun	verb		
noun	verb		
noun	noun	verb	
noun	noun	verb	
noun	verb	noun	

The poem was then asked for. After reading it over and saying "It has possibilities; I think I'll change it a bit," he made some changes. Here is the initial poem, followed by the revised one.

air	stare	perhaps	fraction
carefully	is	like	everything
carefully	arranging	like	spring
flower	stare		
people	stare		
hand	breaking		
air	people	stare	
fraction	anything	look	
everything	breaking	anything	flower

The revision was extensive:

air is a perhaps fraction of stone
carefully put is everything
carefully arranging
flower and stone
people and stone
air people flower stone
a fraction of anything—look
anything makes everything

The writer commented, "It looks like having some words that 'go together' will at least create an idea for a poem. These aren't

great poems. They are, in fact pretty bad. But if you experiment with putting them in the file in different ways, and then experiment pulling them out in different patterns, you might get some good notions. And then break away from the computer and write. It has possibilities. But I'd like to be able to change the program. I'd put in more word types. Then I'd put them in so I could retrieve them in more than one way. Like, retrieve by initial letter, part of speech, synonym or antonym, and connotation of good or bad, movement or passivity, or other such things. I've had enough though. The program would bomb with anyone who didn't know much about writing poetry. But it got me thinking. I won't forget it for a while. I doubt I would want to use it again. But it got me thinking. I'll try out some new things."

Brief Summary Flowcharts of Two Persons Going Through a Program and a Narrative for One. This portrayal strategy is based in part on Auerbach's method of formal analysis outlined in Della-Piana (1981, pp. 223-228). The form this takes in the current illustration is a summary flow chart with three representations of paths through the "Poetry" program described above (see Figure 3.0). The center flowchart is our own simplification of the inferred author-designated path through the program. The flowchart on the left is a simplification of the path of an occasional writer of poetry and the one on the right is the path of an inexperienced and reluctant writer. Thus, in a summary fashion we have multipersonal representations of consciousness with three different perspectives as to what is involved in "going through the program." Let us call the occasional writer WRITER, and the other RELUCTANT, using caps in both cases. We follow primarily the thoughts of RELUCTANT, with some reference to WRITER and some to an observer.

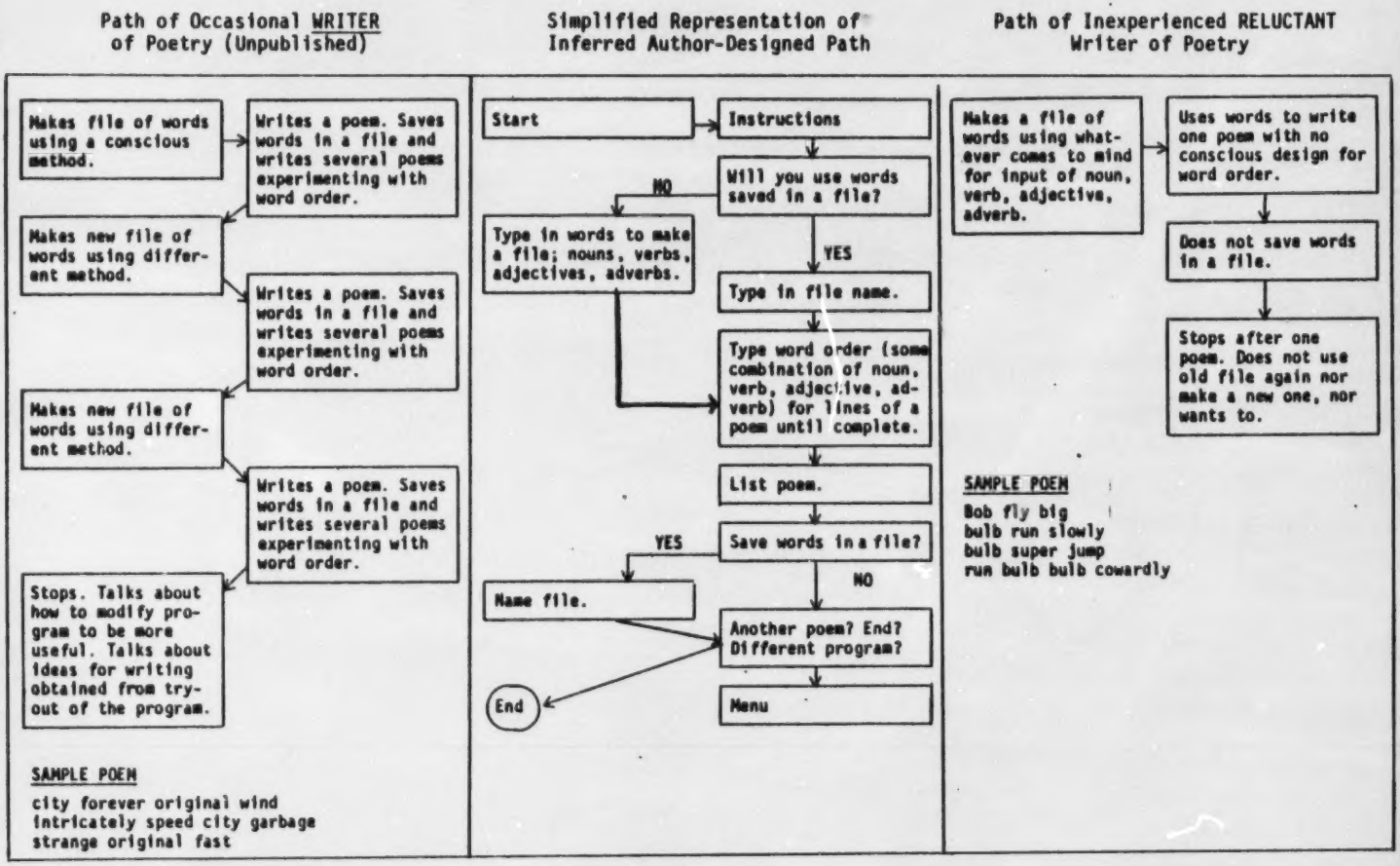
Path of Occasional WRITER of Poetry (Unpublished)
Simplified Representation of Inferred Author-Designed Path
Path of Inexperienced RELUCTANT Writer of Poetry
Makes file of words using a conscious method.
Writes a poem. Saves words in a file and writes several poems experimenting with word order.
Makes new file of words using different method.
Writes a poem. Saves words in a file and writes several poems experimenting with word order.
Makes new file of words using different method.
Writes a poem. Saves words in a file and writes several poems experimenting with word order.
Stops. Talks about how to modify program to be more useful. Talks about ideas for writing obtained from try-out of the program.
SAMPLE POEM
city forever original wind
intricately speed city garbage
strange original fast
Start
Instructions
Will you use words saved in a file?
NO
YES
Type in words to make a file; nouns, verbs, adjectives, adverbs.
Type in file name.
Type word order (some combination of noun, verb, adjective, adverb) for lines of a poem until complete.
List poem.
Save words in a file?
YES
NO
Name file.
Another poem? End? Different program?
End
Menu
Makes a file of words using whatever comes to mind for input of noun, verb, adjective, adverb.
Uses words to write one poem with no conscious design for word order.
Does not save words in a file.
Stops after one poem. Does not use old file again nor make a new one, nor wants to.
SAMPLE POEM
Bob fly big
bulb run slowly
bulb super jump
run bulb bulb cowardly

FIGURE 3.0. Flowchart of simplified, inferred, author-designed path through MECC "Poetry" and two student paths.

RELUCTANT was in the Ninth Grade at the time he tried out the Poetry program. He had above-average performance levels in math and reading, had never written a poem in his life nor wanted to. After getting the diskette going and moving through the initial instructions, he came upon the step, "will you use words saved in a file?" He paused, read the instructions aloud with an incredulous emphasis on "in a file." What does that mean, he thought aloud as he fumbled his way into the instructions to type in words for nouns, verbs, adjectives and adverbs. "And nouns," he thought, "is it o.k. to put in a person, place or thing?" He put in BOB-BOSTON-BULB and smiled as he noted how hard it is to 'think up' a noun and how much easier to label one if someone shows you a list of, say, nouns and verbs. So much for nouns; at least there are some in there now. Verbs. Verbs. He turned to the observer, inquiring whether verbs describe nouns. "Not that it mattered," he thought to himself. His head moved back and forth as if watching a ping-pong game; first puzzling over the meaning of what was on the monitor, and then muttering a question or answer while looking to the observer for confirmation. He gave a sign when finished with inputs and another one when confronted with the puzzle of choosing words by grammatical type and ordering them into lines and verses. "Do I list the poem," he thought, before he even specified the word sequences. He typed a sequence of numbers (1,2,1,5) which represented "noun, verb, noun, list poem," and got the feedback "that is not a number." When he finally got the poem, it was

Bob fly big
bulb run slowly
bulb super jump
run bulb bulb cowardly

He commented upon how he would rather not do it again and thought to himself how painful and useless it was and made moves to leave. The observer was curious about how another poem might turn out and twisted RELUCTANT's arm. RELUCTANT went through the entire painful process again and came out with a decidedly discouraging poem. To get RELUCTANT to make another try, the observer told RELUCTANT about WRITER and how writer tried different ways of putting words in and different sequences for pulling them out and showed him some of the poems. RELUCTANT listened and sometimes saw the observer's lips moving, but strangely heard nothing; other times he heard the words the observer uttered and they matched the observer's lip movements all right, but the words seemed to go over his head, or through him or off of him, off the walls, off anything in the way, or dissolve into the air. No, he wasn't going to try it again no matter how successful or engaging the experience was for WRITER nor how persuasive the observer.

Comments on Interpretation. The three portrayals illustrated above are only a sample of ways in which data may be presented consistent with the perspective and strategy we have outlined. We intend to explore other strategies, including hypothetical dialogue (between student and program developer) and exploratory data analysis. It should be apparent from the illustrative portrayals that we have not made the final judgment for the user. Our hope is that we have done more. Our intent was to portray certain data juxtapoisitons in ways that involve the reader in wanting to make interpretations and to make the courseware transparent so the reader can make interpretations and judgments consistent with intended uses of the courseware. But all this is our own intent. In the next section we propose how we plan to investigate the actual effects of this kind of portrayal.

7.0 Investigation of Portrayal Effects

We have specified some strategy and tactics for gathering in-depth data on courseware packages and for portrayal of that data in alternative forms that might have the effect of involving audiences in making their own interpretations and judgments about the courseware for their own intended use. We have suggested that for the buyer the use would be to guide selection of courseware to "try out." For the teacher managing students using courseware, the purpose would be to guide adaptation of the courseware or proposed utilization procedures for use within their own context. For the designer/developer the purpose might be to motivate redesign and redevelopment or to motivate modifications of representations concerning courseware. Claims or hopes for such effects of portrayals of courseware criticism must be coupled with investigatons. What might be the form of such investigations?

We do not outline methodology for such studies here, but there are some dimensions of the investigations that are worth noting.

The coursework studied should be a package that has been initially screened and found to be educationally valuable, technically competent, thorough in documentation, and widely used. In addition, the publisher should allow printout of student input for purposes of the investigation, subject to appropriate protection of copyright.

The setting of the study should be one where the program is in operation at a stage where most procedural concerns are worked out. The institution naturally should work out a detailed agreement that protects the rights of students and others and clearly specifies what will be done and the rights and responsibilities of all parties.

The specific design would have to be worked out given the context and the decisions of most concern within that context. Thus, the student population sampled would have to be representative of the range of students for whom the program is targeted both by the publisher and the local user. The depth of data gathering would have to be a function of both resources and questions of concern. At any rate, one would end up with data appropriate to the decisions of concern within Table 2.0 or others added by the study group.

Alternative portrayals would be prepared in ways that are designed to achieve the intended purposes. In the case of teachers, one would begin with a systems model of teacher decisions with the context of intended use. Then alternative portrayals of the courseware criticism would be directed toward utility for those decisions and tested against actual teacher responses in an appropriate evaluation study. For the developer, one would begin with a systems model for design and development and prepare alternative portrayals of the courseware criticism directed toward utility for development decisions. Again the alternative portrayals would be tested against actual developer decisions on design or redevelopment using an appropriate evaluation study.

For an excellent summary of approaches to the study of utilization of evaluation reports, see Weiss (1982). After a consideration of conceptualization of use, Weiss cites a variety of studies in which observation, interview, the tracking of documents, and participant-observation methodological strategies were used to answer questions concerning effects of evaluations on people, resolution of issues, and organizational behavior.

8.0 Courseware Criticism Checklist

We noted at the end of Section 4.0 that we would propose an alternative to the in-depth analysis outlined in this paper. The alternative is an open-ended checklist that goes beyond the simplicity of the usual rating sheets, but not as far as the in-depth procedures we have outlined above. We have completed the checklist only for "student path." Our intent is to eventually develop a checklist for the major data sources noted in Figure 1.0. The use of this checklist will require training and provision of many examples of its use in different contexts.

In Appendix B we present the "open-ended checklist." On the following pages we present one illustration of the kind of data that may be gathered with the checklist. The program used for the tryout is "Arithmetic Racing," a drill and practice program in arithmetic fundamentals published by Math Software, 1980. The form of our portrayal is simply the checklist itself with observations and student responses written in. This is certainly one useful portrayal method, although we believe it would be important to experiment with alternative portrayals such as, for example, a hypothetical dialogue between the student and the developer using the open-ended checklist data plus program documentation. Following the illustrative example of the open-ended checklist data, we have included the Northwest Regional Educational Laboratory Microsift evaluation of the same program to illustrate the typical checklist approach.

Sample Completed Checklist Based on Teacher Observation of one Student in the Program

MICROCOMPUTER COURSEWARE EVALUATION OPEN CHECKLIST

Student: Grade 5.5, male. Accurate in basic operations but low test scores on speeded tests.

Instructions: Where a yes/no is asked for, circle your response. For open-ended questions, write in your response in the space provided. Be brief, descriptive, and to the point. Use typical examples of student performance where appropriate.

1. Can the student start up the program? Yes (No)

   If not, what skills or additional information must the student have in order to start?

   Student must have knowledge about "how to start the system" and/or to "boot" the system if diskette and hardware are DOS incompatible

2. Can the student proceed through the program with the information provided? Yes No *Somewhat*
   somewhat

   a. If ~~yes~~, by what means does the student do it?

      _____ displayed instructions

      _____ manual/workbook

      _____ other *asked teacher to clarify what to do*

   b. If no, what skills or additional information must the student have?

3. Does the student have a Yes/No option for instructions at the beginning of the program? Yes (No)

4. What does the student actually do when beginning instructions are unclear?

   Asked teacher "what do I do?"

5. Does the student have the option to go back to the instructions? Yes (No)

   If no, how does the student proceed in order to get the necessary information to go on? *When teacher was asked "what do I do?", she said "What do you think you should do?" Student just went on through the program.*

6. Can the student control the path of instruction? (Yes) No

   a. In which way?

      _____ skip sections

      _____ go back

      _x_ increase or decrease speed *select Levels (1=much time and 5=little time) of time allowed for answer.*

      _x_ level of difficulty *"largest number to operate on"*

      _x_ other *choice of arithmetic operations*

   b. Does the student know what the consequences are for each choice?
      Yes No *Not at first. But by the end of three 5-minute sessions student grasps all options.*

   c. What were the student's reasons for making the choices he/she did make? *Chose multiplication "because I like it and I'm good at it." Avoided subtraction and division "cause they are harder." Chose high speeds "cause I'm good" but lowered to Level three when in difficulty.*

7. Can the student input responses called for? Yes No

   What kind of responses are asked for?

   (a.) Numerical; what is the input order? (Left to right)
   Right to left
   Inconsistent--*no.*

   b. Alphanumeric/verbal? One letter One word Phrase

      Is word order and spelling important for correct evaluation of student input? Yes No *Does not apply.*

8. What does the student do when the instructions to do something are not clear? For example, how does the student attempt to get clarification or otherwise react to the lack of clarity? *Asks teacher or thinks out loud with comments or rhetorical questions like "I wonder how they figure points?" or "what do you mean 'watch my speed'. I was fast and got it wrong. Oh?"*

9. Can the student correct an input before the computer evaluates the input? (Yes) No *Only on speed level, however. This student hung system by pressing reset and trying to exit during the drill.*

10. Is the student correction of input errors aided by provision of program messages? Yes (No)

11. How are correct responses acknowledged or confirmed?

    a. _x_ graphics

       _x_ exclamatory remarks

11. a. (continued)

__x__ sound

__x__ continuation of program

b. Describe any special features of the confirmation. *Sound feedback (a "charge" song), exclamatory remark "Yes NAME Keep Racing!", score, after 10 problems: flags portrayed in different color rectangles like racing flags, the remark "charge arithmetic racer" and then score and bonus points.*

c. What is the effect of the confirmation on the student?

student mimicked the "charge" song

12. How are incorrect responses acknowledged or corrected?

a. _____ graphics

__x__ exclamatory remarks

__x__ sound

__x__ continuation of program

b. If error recognition and correction messages are so general that they miss important features of the student's errors, give an example of the student error and the acknowledgement and correction message. *Student commented out loud "I added instead of multiplying" or "I hit the wrong key. I was thinking the right number." Feedback was "watch your speed NAME. The answer is x .*

c. Describe any other special features of acknowledgement or correction of errors.

Program continues to next problem.

d. What is the student's response to the acknowledgement of error? *"that is what I put in." or "oh, is that the answer?" or "I'm not very good at this." or "I always get confused.*

To the error correction process? *"I'll have to try harder" or "I'll have to remember the answer."*

To error messages that do not discriminate his/her specific error? *"Wait a minute. My answer was wrong, it wasn't slow. Why does it say "watch your speed." Oh, I see. That is clever. If I go too fast and get it wrong, it says "watch your speed." If I go too slow and get it right, it still says "watch your speed."*

13. What student accomplishments (beyond the single response) are singled out for "reward" or special commendation through program feedback? *See #11. After every 10 problems you get flags and stuff and you can raise your points by choosing harder problems (higher numbers), more operations, or higher speeds. But these are not noted specifically. You figure that out or read it in the manual.*

What criteria are used for "successful accomplishment?"

correct answer
under speed limit
selection of larger numbers
choice of arithmetic operation

14. How does the student respond to special commendation or reward systems of the program?

This student just mimicked the "charge song" or said "I'm good at this."

15. Does the student have an option to repeat the program or end?
(Yes) No

a. If the student attempts to repeat, what happens?

goes back to selecting another arithmetic operation (or same one), largest number desired, and the speed level for making a response.

How does the student react? *See #6 above. This student chose multiplication most, started at high speeds and lowered them, and slowly made numbers higher (under coaxing from teacher).*

b. If the student attempts to end, what happens?

gets blank screen with flashing cursor.

How does the student react?

Asks "what do I do now?"

16. When the student completes the session, what does he/she say in response to the following questions:

a. What was the lesson about? Tell me more.
Student laughed and said, "Doing arithmetic. Like multiplication and addition and stuff."

16. (continued)

b. Do you think this kind of work will help you? How?

"It would if I practiced what I need, like subtraction and division. But I like multiplications so I did it most."

c. What were the difficulties you encountered in going through the lessons?

"My fingers hit the wrong keys cause I was trying to go fast. And I got tired of the title and address and stuff every time you start over."

d. Would you recommend this program to other students? *Yeah.*

Who would they be? *"My friends."*

Why? *"So they can play the games after."* *Anything else?*

"Oh, they can do arithmetic."

Why not?

Arithmetic Racing

PRODUCER: Math Software
1233 Blackthorne Place
Deerfield, IL 60013

LOCAL DISTRIBUTORS: Contact producer for list

EVALUATION COMPLETED: Fall 1981; Revised 2/1/82

VERSION: © 1980

COST: Not sold individually; sold in packages of 5 to 10 programs ranging from $100 to $250

ABILITY LEVEL: Grades 4-11
SUBJECT: Mathematics: speed and accuracy drill of arithmetic operations
MEDIUM OF TRANSFER: 5" flexible disk
REQUIRED HARDWARE: 32K Apple II or II Plus, one disk drive, monitor
REQUIRED SOFTWARE: DOS 3.2 or 3.3, Applesoft
INSTRUCTIONAL PURPOSE: Standard instruction, enrichment
INSTRUCTIONAL TECHNIQUES: Game, problem solving, drill and practice
DOCUMENTATION AVAILABLE: Suggested grade level, program operating instructions, demonstration

INSTRUCTIONAL OBJECTIVES: To improve students' arithmetic skills in addition, multiplication, subtraction, and division; to provide an interesting interactive environment for remediation work in arithmetic facts; and to develop speed and accuracy in working basic arithmetic operations.

INSTRUCTIONAL PREREQUISITES: The program assumes that students know basic arithmetic facts concerning the operations of addition, multiplication, subtraction and division. Students also need to understand the rules governing the operation of the computer game.

CONTENT AND STRUCTURE: ARITHMETIC RACING is a game of timed arithmetic practice for students Grades 4-11. Players first select addition, subtraction, multiplication, or division and then specify the largest number they want the computer to give them. Players also select a speed level from 1-5. The computer then assigns a point value to each problem based on these selections. A 25 point bonus is added to the score for answering each of the ten questions correctly.

ESTIMATED STUDENT TIME REQUIRED: Not available

POTENTIAL USES: The program may be used in a classroom setting to provide drill and practice in basic arithmetic operations.

MAJOR STRENGTHS: The game format offers an incentive for students needing drill and practice in arithmetic operations.

MAJOR WEAKNESSES: None cited.

EVALUATION SUMMARY

SA	A	D	SD	NA	
	•				Content is accurate.
•					Content has educational value.
				•	Content is free of stereotypes.
	•				Purpose of package is well defined.
	•				Package achieves defined purpose.
	•				Content presentation is clear and logical.
	•				Difficulty level is appropriate to audience.
•					Graphics/sound/color are used appropriately.
	•				Use of package is motivational.
	•				Student creativity is effectively stimulated.
	•				Feedback is effectively employed.

SA	A	D	SD	NA	
	•				Learner controls rate and sequence.
	•				Instruction integrates with prior learning.
	•				Learning can be generalized.
	•				User support materials are comprehensive.
	•				User support materials are effective.
	•				Information displays are effective.
	•				Users can operate easily and independently.
	•				Teachers can employ package easily.
	•				Computer capabilities are used appropriately.
	•				Program is reliable in normal use.

SA - Strongly Agree A - Agree D - Disagree SD - Strongly Disagree NA - Not Applicable

Evaluators indicate they would use or recommend use of package with little or no change.

Northwest Regional Educational Laboratory
300 S.W. Sixth Avenue • Portland, Oregon 97204
(503) 248-6800

This evaluation is based on the evaluations of three or more reviewers who are representative of potential users of the courseware package.

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9.0 Epilogue

There must be some word or two to provide a kind of closure or anticlosure for a document such as this. It seems to us that the state of the art in courseware criticism calls for anticlosure.

Paul Heckel writes that "There may be disagreements on who the typical user for a product is, but the best designs are those created by people who have a clear and realistic picture of the ultimate user" (Heckel, 1982, p. 12). In a series of articles on "intelligence design" or "software for people" in *InfoWorld* beginning with the July 19, 1982, issue, Heckel keeps this "user orientation" alive as he considers the design of communications with a concern for visual processes of the user, empathy with the user, user control, helping the user to cope, leading the user without a manual, making complex design appear simple, and so on. The emphasis is always on the user; "The organization that is important is not that which appears on the screen, but that which is created in the user's mind" (Heckel, 1982a, p. 27). As with Heckel's design of courseware, so may it be with courseware criticism. It is informed by the user and portrayed for the user.

APPENDIX A

STRUCTURED OBSERVATION OF STUDENT PATH IN GOING THROUGH MICROCOMPUTER COURSEWARE

Materials to Have Ready

- Computers in working order, preferably with print capability for collecting student responses.
- Diskette(s) for review.
- Workbook or other hard copy material if available. Two copies, one for student(s) and one for an "observer."
- Stopwatch to time segments of the work.
- Extra paper for use if needed by student and notebook for "observer."
- Tape recorder to pick up student's thinking when "thinking aloud" and at probing points.
- Pens for student and observer. Do not use pencils since a complete record with no erasures and no crossouts is desired.

Tryout Space Arranged

- Quiet area free from interruptions or observers.
- Comfortable chair for student to work at computer with space and lighting for writing in workbook.
- Chair for observer next to student so that student's work can be observed on the computer and in the workbook.
- Writing surface of observer.

Guidelines for Activity During the Tryout:

Explain to Student the Purpose of the Tryout

- It is to test the material, not the student.
- We wish to find out how people use the material and what they find most useful or interesting.
- We wish to know where it is easy and where it is difficult so that we can find better ways of using the material to make it easier for others.

Ask Student to Make Responses Orally and in Writing So That You Can Follow His/Her Thinking

- "Think and talk out loud" as much as possible.
- Write down your answer completely where possible or necessary.

- Do not scratch out anything written so that it cannot be read.
- Work at a comfortable pace, but slow enough so that the observer can follow.
- As much as possible, write in the notebook or scratch paper in sequence so we can tell the order in which the work was done.

Tell the Student What You (TA) Will Be Doing

- Collecting print copy of student responses if possible ("so I can go back to specific places and ask you what you did or thought at that point").
- Taking notes ("so I can go back to them to see how people use the materials").
- Observing ("to see how it works, and to mark down where it is easy, where difficult").
- Timing ("to see how long different segments take. But don't try to rush it. We want to see how long it takes at an easy pace.").
- Taping ("so I can listen to it and follow your thinking").
- Probing or questioning ("so I can get a clearer picture of your thinking at places where it is difficult or more interesting").

Respond to Student When Asked "What Do I Do Now (Next)?" or "What Does This Mean?" At Any Time During the Work

- Say "do what you think it asks you to do."
- Say "read what it says (on the monitor/in the workbook) again and see if it makes sense."
- If necessary, write out additional instructions in the student's book to help make it clearer, or use notepaper, but keep a record of what you wrote since this is part of the course now. If you do say something orally, write it down also.

Structured Interview Following Completion of Courseware Segment

Probing Points: Probe at Points Marked by You As Student Goes Through the Course

- "Error" points (where student response is not the "keyed response").
- Long latency points (where there was a long delay in student response or the student indicated something had gone awry or that something was being deliberated).
- Ambiguity points (where student comment indicated unclear or ambiguous material, whether the implication was a "material deficiency" or "personal deficiency").
- Appropriateness points (where student comments on how the course "should be" ideally, with or without specific criterion evidence to support the judgment).

- High-utility points (where student comments on particular interest, usefulness or value of the course or activity). End on this positive kind of probe.

Probing Procedure (preferably after each course segment)

- Refer to or point to or bring back on the screen or turn to workbook page or printout where probe is focused.
- Say something like "I noticed you (did, said, etc.) at this point."
- Ask open-ended questions about the point first (could you tell me more about what you were thinking at this point, what went through your head, what ideas you had or steps you went through).
- Ask for "anything else" to get the student to pursue further his/her thought processes.
- If the student is upset, use an appropriate "supportive" and "accepting" style that is honest.
- Probe for specific questions if any are left after the open-ended probe (e.g., "so you weren't sure if it meant 'this' or 'that'— can you tell me how you thought about the choice and how it came out this way?").

Summation Probes or Exit Interview After Completion of Diskette and Related Hard Copy Material

- What were the major obstacles or problems in going through the lessons?
- Would you recommend it to other students? Why? Why not? Any use for it that you can see?
- Do you have any other comments about the course and about my observing and making notes this way?
- Thank the student appropriately and sincerely comment on special features of the student's work you found most pleasing or commendable.

APPENDIX B

MICROCOMPUTER COURSEWARE EVALUATION
OPEN-ENDED CHECKLIST

Instructions: This checklist requires observation of a student going through courseware instruction along with occasional interview or questioning of the student.

- Prior to beginning the observation-interview, go through the program or part of it yourself to get acquainted with the procedure.
- Use this checklist to note your own responses in using the course.
- Select a student typical of the population for whom the course was designed.
- Explain to the student that you are check out the computer and the course so that you will know more about how it works.
- Tell the student you would like him/her to go through the program "thinking out loud" as he/she goes along so that you can get an idea of what is going on in his/her head.
- Demonstrate the "thinking out loud" by using a different program, and then have the student use that program to practice "thinking out loud" as he/she goes along.
- Have an open-ended checklist available with space between items to allow writing in observations. Use a cassette tape recorder if you can or even a videotape recorder if possible. Use a clipboard for writing.

MICROCOMPUTER COURSEWARE EVALUATION OPEN CHECKLIST

Instructions: Where a yes/no is asked for, circle your response. For open-ended questions, write in your response in the space provided. Be brief, descriptive, and to the point. Use typical examples of student performance where appropriate.

1. Can the student start up the program? Yes No

   If not, what skills or additional information must the student have in order to start?

2. Can the student proceed through the program with the information provided? Yes No

   a. If yes, by what means does the student do it?

      _____ displayed instructions

      _____ manual/workbook

      _____ other _____

   b. If no, what skills or additional information must the student have?

3. Does the student have a Yes/No option for instructions at the beginning of the program? Yes No

4. What does the student actually do when beginning instructions are unclear?

5. Does the student have the option to go back to the instructions? Yes No

   If no, how does the student proceed in order to get the necessary information to go on?

6. Can the student control the path of instruction? Yes No

   a. In which way?

      _____ skip sections

      _____ go back

      _____ increase or decrease speed

      _____ level of difficulty

      _____ other _____

   b. Does the student know what the consequences are for each choice? Yes No

   c. What were the student's reasons for making the choices he/she did make?

7. Can the student input responses called for? Yes No

   What kind of responses are asked for?

   a. Numerical; what is the input order? Left to right
      Right to left
      Inconsistent

   b. Alphanumeric/verbal? One letter One word Phrase

      Is word order and spelling important for correct evaluation of student input? Yes No

8. What does the student do when the instructions to do something are not clear? For example, how does the student attempt to get clarification or otherwise react to the lack of clarity?

9. Can the student correct an input before the computer evaluates the input? Yes No

10. Is the student correction of input errors aided by provision of program messages? Yes No

11. How are correct responses acknowledged or confirmed?

    a. _____ graphics

       _____ exclamatory remarks

11. a. (continued)

_____ sound

_____ continuation of program

b. Describe any special features of the confirmation.

c. What is the effect of the confirmation on the student?

12. How are incorrect responses acknowledged or corrected?

a. _____ graphics

_____ exclamatory remarks

_____ sound

_____ continuation of program

b. If error recognition and correction messages are so general that they miss important features of the student's errors, give an example of the student error and the acknowledgement and correction message.

c. Describe any other special features of acknowledgement or correction of errors.

d. What is the student's response to the acknowledgement of error?

To the error correction process?

To error messages that do not discriminate his/her specific error?

13. What student accomplishments (beyond the single response) are singled out for "reward" or special commendation through program feedback?

What criteria are used for "successful accomplishment?"

14. How does the student respond to special commendation or reward systems of the program?

15. Does the student have an option to repeat the program or end?
Yes No

a. If the student attempts to repeat, what happens?

How does the student react?

b. If the student attempts to end, what happens?

How does the student react?

16. When the student completes the session, what does he/she say in response to the following questions:

a. What was the lesson about? Tell me more.

16. (continued)

b. Do you think this kind of work will help you? How?

c. What were the difficulties you encountered in going through the lessons?

d. Would you recommend this program to other students?

Who would they be?

Why?

Why not?

LIST OF REFERENCES

Bronfenbrenner, U. *The Ecology of Human Development.* Cambridge: Harvard University Press, 1979.

Calfee, R. "Cognitive Psychology and Educational Practice," in *Review of Research in Education,* David C. Berliner, Ed. Washington, D.C.: American Educational Research Association (1981), pp. 3-73.

Della-Piana, G. "Literary and Film Criticism," in *Metaphors for Evaluation: Sources of New Methods,* Nick L. Smith, Ed. Beverly Hills: Sage (1981), pp. 211-246.

Della-Piana, G. "Film Criticism," in *New Techniques for Evaluation,* Nick L. Smith, Ed. Beverly Hills: Sage (1981), pp. 274-285.

Della-Piana, G. "Film Criticism and Micro-Computer Courseware Evaluation," in *Field Assessments of Innovative Evaluation Methods,* Nick L. Smith, Ed. San Francisco: Jossey Bass (1982), pp. 11-28.

Gilbert, T. F. "Saying What a Subject Matter Is." *Instructional Science, 5* (1976), pp. 29-53.

Gilbert, T. F. *Human Competence: Engineering Worthy Performance.* New York: McGraw-Hill, 1978.

Glaser, R. "Instructional Psychology: Past, Present and Future." *American Psychologist, 37(3)* (1982), pp. 292-305.

Guba, E., and Lincoln, Y. S. *Effective Evaluation: Improving the Usefulness of Evaluation Results Through Responsive and Naturalistic Approaches.* San Francisco: Jossey-Bass, Inc., 1981.

Heckel, P. "Maxim for 'Intelligence Design': Know Your Users." *Info World, 4(28)* (July 19, 1982), pp. 11, 12.

Heckel, P. "Communicate in Specifics." *Info World, 4(34)* (August 30, 1982), pp. 26, 27.

Resnick, L. B. "Instructional Psychology." *Annual Review of Psychology, 32* (1981), pp. 659-704.

Simon, H. A. "Designing Organizations for an Information-Rich World," in *Computers, Communications, and the Public Interest,* M. Greenberger, Ed. Baltimore: Johns Hopkins University Press, 1971.

Smith, N. L., Ed. *Communication Strategies in Evaluation.* Beverly Hills: Sage, 1982.

Weiss, C. H. "Measuring the Use of Evaluation," in *Evaluation Studies Review Annual, 7*, E. R. House, Ed. Beverly Hills: Sage (1982), pp. 129-145.